SECTION 17: TRANSPORTATION AND MATERIALS HANDLING SYSTEMS

17.1 GENERAL. This section provides guidance for the study, selection and design of transportation and material handling systems and establishes requirements for elevators, dumbwaiters, pneumatic tube systems, material delivery equipment, pedestrian traffic, service cart systems, and gravity chute return systems for linen and trash in military healthcare facilities. The section is not intended to cover all aspects of transportation analysis or design, but rather to act as a standard for use by qualified medical transport consultants (MTC).

17.1.1 Scope. This section applies to horizontal and vertical circulation within healthcare facilities, and the transportation devices, equipment and methodologies required for efficient, cost effective and timely movement of people, equipment, materials, and related materials management functions. Program factors for patient beds, healthcare procedures and departmental workloads should be provided by the user service and should be utilized in computing traffic demand loads. Select vertical transportation on the basis of acceptable response and waiting time intervals. Calculate the intervals from an analysis of elevator car speed, traffic transfer time, door operation cycle and other applicable system capacity factors.

17.1.2 Waste Management. Section 18, Waste Management, of this Military Handbook is the primary reference for medical facility waste definition, handling, and disposal; closely coordinate transportation systems studies and design with the contents of that Section.

17.1.3 Construction Phasing. Where phased construction is necessary, provide studies and designs for each phase. Provide design for transport system elements not required until later stages to allow for phased installation. Phased installation shall be accomplished with a minimum of rework and without major disruptions to the facility's operations. Give specific consideration to placement of transport devices for present functions and for possible future facility modification.

17.1.4 Addition and Alteration Projects. These criteria are intended primarily for new construction, however addition and alteration projects will meet these criteria to the extent practicable. When additional elevator banks are to be provided for facility additions, they must be located along the same major circulation paths that serve the existing elevators, where feasible. See also Paragraph 17.5.3.6.

17.1.5 Area Allocations. Base the floor area requirements for transportation equipment on the specific equipment included in the transportation analysis. The area allocated for such conveyances is part of the central circulation factor. Additional area for penthouses or other transportation equipment rooms will be considered part of the mechanical space allotment. Consider shaft space as part of the circulation allotment. If the transportation analysis justifies a system requiring more than the assigned area, additional space for elevator lobbies, cart queuing space, shafts and penthouses must be identified early in the Concept Design phase. The designer will submit justification for deviations from criteria, and illustrate how additional area allowances would increase operational efficiency, improve service to patients, or reduce costs. Systems not providing high utilization

of equipment, such as dedicated elevators for movement of patients from emergency to surgery, must be justified on the basis of required planning configuration, the segregation of incompatible traffic, or operational economical benefits.

17.2 TRAFFIC SEPARATION AND CIRCULATION. Traffic is categorized as follows:

a. Pedestrian - inpatient, outpatient, staff and visitor;
b. Vehicular - patient transport;
c. Equipment/Materials - sterile, clean and soiled equipment and materials.

Review each category independently to determine its unique transportation requirements.

17.2.1 Traffic Separation. Establish traffic patterns to separate the various traffic types in an efficient, logical, safe and secure manner, while maintaining levels of aseptic control consistent with the requirements of the facility. Consider all of the following factors for separation for both horizontal and vertical circulation: patient privacy; handicapped access; aseptic control; routing efficiency; utilization of appropriate hardware systems, safety and security. Where circulation conflicts occur, prioritize traffic as follows:

a. Patient
b. Staff
c. Equipment
d. Visitors
e. Materials/logistics.

When a facility is sufficiently large and complex to require more than four elevators, separate passenger and vehicular elevators.

17.2.2 Circulation. Design the overall circulation to provide the most direct routing practical. Place elevators on the direct horizontal path between the areas they serve, wherever possible.

17.2.3 Equipment/MaterialsCirculation. Separate the equipment/materials traffic from patient and visitor traffic as noted on the Elevator Traffic Separation Guide Matrix, Figure 17.1. Where separate elevators are not required, separate the materials traffic by schedule and policy. Careful, simple and clear space planning can maximize separation between visitor/patient and staff/materials/logistics. Primary horizontal materials circulation should occur on a single level, with vertical penetrations that are convenient to heavy use areas. It is undesirable for carts, pallet trucks, and similar material carriers to be pushed long distances on floors and corridors routinely traveled by patients or visitors. Establish horizontal right-of-ways to:

a. Aid in directing traffic to the appropriate vertical core, while avoiding inappropriate elevators and other building areas.
b. Provide high levels of patient privacy.
c. Eliminate potential contamination of clean and sterile areas.

17.2.4 Automated Cart Traffic. Do not plan automated cart traffic in

corridors, or spaces, with patient or visitor traffic. Automated cart traffic may occur in staff corridors and dedicated spaces, provided adequate warning and safety devices are furnished. Vertical movement of automated carts shall occur in dedicated elevators. Arrange cart lifts to provide adequate cart staging that is independent of workroom or circulation areas.

17.2.5 Clean and Soiled Material Separation. Materials management programs shall provide for clean and soiled separation consistent with all applicable codes and standards, including those of the Joint Commission for the Accreditation of Healthcare Organizations (JCAHO).

17.2.5.1 Soiled Material. Soiled materials are normally transported in separate covered or closed carts designed to provide containment of the material. Soiled material transport may occur in the same corridor and elevator systems that handle other traffic; however, soiled materials are not transported on the same elevator at the same time with patients, visitors, or clean or sterile materials. Transport circulation design shall allow soiled carts to be adequately washed prior to reuse as a soiled container, and washed and sanitized prior to use for clean materials.

17.2.5.2 Sterile Material. Transport all sterile material for use in Surgery, Catheterization and Labor/Delivery or other areas requiring sound aseptic controls from the sterile processing / storage area to its destination via a clean route that will not compromise the integrity of the material. Where case carts are used, they shall be transported from sterile storage to the clean surgical core by means that protect the cart and its contents from contact with less clean environments.

17.2.6 Palleted Material. Except in warehouses and bulk storage areas, materials shall not normally be moved on pallets beyond the main receiving and storage areas.

17.2.7 Elevator Traffic Separation Guideline ETSG. Figure 17.1 provides a matrix showing general guidelines for the separation of traffic. To use the Elevator Traffic Separation Guideline, review the "Characteristics" column for the approximate conditions represented by the project. Then review the column represented by the "Facility Type" being considered to determine general separation considerations. The most severe separations are to be followed. Each individual facility must be analyzed for unique considerations; however, vertical traffic separation will follow Figure 17.1, as a general guideline.

17.3 TRAFFIC FLOW RATES AND QUEUING. Design general circulation right-of-way, including corridors, staircases and lobbies to provide the following general flow and queuing rates:

17.3.1 Corridor Widths. Design corridor widths to provide average flow volumes through corridors of a maximum of 3 to 4.5 pedestrians per meter of walkway width, per minute (10 to 15 pedestrians per foot of walkway width, per minute). Corridor widths should be not less than 1.8 meters (6 feet) for patient/visitor corridors and 2.4 meters (8 feet) for patient corridors with gurneys and/or carts.

17.3.2 Pedestrian Area. Average Pedestrian Area Occupancy (APAO) shall not be less than 1.4 sm (15 sf) per person in walkways.

17.3.3 Open Lobby Queuing. Average queuing level for open lobby areas

(ingress / egress) points shall approximate 1.2 sm (13 sf) per person, leaving inter-person spacing of approximately 1.22 m (4 ft).

17.3.4 Informal Queuing. Informal, unorganized queuing in service areas shall be no less than 0.93 sm (10 sf) per person.

17.3.5 Ordered Queuing. Queuing in ordered queue areas, such as lines at outpatient pharmacy windows and in elevator lobbies, shall be not less than 0.65 sm (7 sf) per person.

17.4 Ramps. Avoid the use of ramps. If ramps must be used, the maximum slope shall be less than 1:20, and the ramp must comply with the applicable sections of the Americans with Disabilities Act Accessibility Guidelines (ADAAG). See Section 12 of this Military Handbook for additional information.

17.5 Elevator and Escalator Planning Factors.

17.5.1 Population. The populations to be considered for each building type are as follows:

17.5.1.1 Staff. Determine staff populations for each area within a given facility by actual number, not by Full Time Equivalent FTE (i.e., two 20 hour per week employees are equal to two staffers, not one FTE).

17.5.1.2 Patient. Patient populations include all persons receiving treatment at the facility. They are categorized as inpatient when they occupy an inpatient bed overnight, and as outpatient when treatment does not require an overnight stay.

17.5.1.3 Visitors. Calculate visitor populations from data supplied by the facility. Visitors shall include all persons not accounted for as staff or as patients, including but not limited to:

a. Persons visiting inpatients and accompanying outpatients.
b. Persons who are picking up or dropping off specimens, pharmaceuticals, records or X- rays.
c. Salespersons;
d. Students, outside maintenance people and others as applicable to the facility in question.

17.5.2 Traffic Patterns, Migration. Review each facility for general circulation and right-of-way. Where pedestrians have the option of using more than one elevator group, increase the elevator population predicted for each individual group by a migration factor of at least 10 percent. Consider greater factors for elevators in close proximity to cafeterias, main ingress/egress areas, etc. The design must also consider migration of staff, visitors and patient vehicular traffic to service cars. A factor of at least 10% of the staff should be considered in the service elevator car handling capacity.

17.5.3 Elevator Traffic Study and Analysis ETSA. Prepare the Elevator Traffic Study and Analysis to determine the appropriate types, locations, sizes, speeds and groupings of elevators. For facilities less than 4,640 gross square meters (50,000 GSF), an elevator traffic study and analysis may not be required. Determine the loading density and the load-unload time for each

facility during site visits to account for unique conditions at a facility and the cultural aspects of the area (i.e., amount of "personal space" required by individuals; number of visitors per patient; number of escorts or companions accompanying outpatients; etc.).

17.5.3.1 Elevator Loading Densities. Maximum estimated densities for elevator loading will approximate:

a. 0.23 to 0.325 sm (2.5 to 3.5 sf) per pedestrian.
b. 0.42 to 0.6 sm (4.5 to 6.5 sf) for a person on crutches/walker.
c. 0.6 to 0.79 sm (6.5 to 8.5 sf) per wheelchair.
d. 1.3 to 1.5 sm (14 to 16 sf) per gurney.
e. 1.67 to 2.23 sm (18 to 24 sf) per bed.

Verify average loading densities during site visits of existing facilities.

17.5.3.2 Elevator Load and Unload Times. Estimated average load and unload times, using the elevators as specified herein, will approximate the following times:

a. 2.2 to 2.4 seconds per normal pedestrians in passenger elevator cars;
b. 2.2 to 3.4 seconds per pedestrian impaired by medical/pharmacological treatment.
c. 4.8 to 8.0 seconds per wheelchair.
d. 4.4 to 9.6 seconds per person on crutches/walkers.
e. 7.5 to 12.0 seconds per gurney.
f. 8.8 to 15.0 seconds per bed.

Verify average load and unload times during site visits to existing facilities.

17.5.3.3 Elevator Traffic Analysis. For passenger and patient service elevators, base the elevator traffic analysis on average high peak traffic conditions over a period of fifteen minutes or less.

17.5.3.4 Passenger Elevators. For passenger elevators, the Elevator Traffic Study and Analysis must evaluate all peak periods, including but not limited to:

a. Morning Shift Change Peak (primarily an up-peak period).
b. Lunch Peak (heavy two way traffic).
c. Afternoon Shift Change Peak (primarily heavy down peak, with moderate opposing traffic).

When determining elevator loading, factor the number of persons/vehicles that can physically load into an elevator into the traffic study. Loading densities for hospital and outpatient clinic elevator cars are unlike elevator populations in most other buildings. Where pedestrian traffic is mixed with substantial vehicular traffic, the space used by carts, gurneys, beds, portable X-Ray equipment and the like, must be factored into the Elevator Traffic Study and Analysis. Identify impacts of overlapping traffic patterns between inpatient and outpatient functions. In existing buildings, the populations must be studied during site visits to determine the percentage of traffic that is consumed by crutches, braces, wheelchairs, casts, and similar items.

17.5.3.5 Patient Service Elevator Cars. For patient service cars, evaluate the primary inpatient transportation period to determine if patient service elevator cars have excess capacity which can augment passenger elevator cars during peak pedestrian periods. Under normal operation, all elevators, which operate as a group, have circuitry that monitors cars in operation. When one or more cars are out of service, the monitoring or dispatching system senses the condition and automatically selects an available car within the group for response to hall calls. During an emergency power condition, the ASME A17.1 Code requires all groups of elevators, which are supplied with an alternate power source, to automatically sequence one at a time to the main egress level. Once all cars have reached the designated level, the elevator system must automatically select one car within the group to operate. A manual override switch must also be provided, so emergency personnel may select a particular car if desired.

17.5.3.6 Addition/Alteration Projects. For Addition/Alteration projects, provide specific recommendations on how the addition will augment the existing building systems. Potential migrations from existing buildings, for the purpose of using superior transportation elements in the addition, must be considered in the new building populations.

17.5.3.7 Materials Handling and Logistics Elevators. For materials handling and logistics elevators (manual systems), base the Elevator Traffic Study and Analysis on the materials and cart traffic predicted by the materials management and handling programs, plus 20% spare capacity, during the peak hour, for non-scheduled moves, plus an additional 20% spare capacity to allow for materials handling and materials management program flexibility. In the absence of definitive operational schedules and anticipated commodity delivery criteria from the user service, assume the peak hourly demand for material delivery and non-ambulatory patient traffic to be 10 percent of the combined total daily traffic load for the Elevator Traffic Study and Analysis.

17.5.4 Escalators. Consider escalators for pedestrian traffic where justified by traffic studies. Consider escalators for frequent vertical movement of large numbers of people in multi-floor outpatient clinics which exceed 2,000 patient visits per day, or in hospitals which exceed a 500 bed capacity and have principal patient entrances on two levels. Escalators are not subject to analysis or criteria measurements for average intervals. Design escalators to handle large numbers of pedestrians in a safe and efficient manner. Designs shall consider that traffic will include persons who may be slightly impeded by physical disabilities or by virtue of medical / pharmacological treatment. Design escalators with safe travel speeds and adequate entrance and exit queuing areas to handle the expected volumes. The minimum escalator width will be 815 mm (32 inches) and the rated step speed will not exceed 450 mm/second (90 fpm.)

17.6 Elevator Performance Criteria. Elevators provide the basic transportation mechanism for most vertical moves in multistory buildings. Selection of the proper number, type, speed, location and general characteristics for elevators is crucial to an efficient and effective transportation system. Provide the minimum number of elevators necessary that will satisfy the following criteria:

17.6.1 Average Interval. Figure 17.2 provides requirements for average intervals for passenger cars, combined use and patient service cab and dedicated materials cars. These average interval times do not specify a

particular calculation procedure that should be utilized in ascertaining the desired result (i.e., an acceptable response time). Base elevator calculations on the areas served. The designer may utilize any suitable calculation procedure provided that all assumptions and logic flow/calculations in the analysis are clearly stated. In addition, the designer will consider loading/unloading time, door operation time, elevator velocities/accelerations and any other parameters that influence the round trip time utilized in the analysis (state all assumptions built into this value.) Alternate systems proposed will be evaluated utilizing a life-cycle-cost analysis.

17.6.2 Passenger Handling Capacity. Where the exact peak traffic conditions cannot be obtained or calculated for a given facility, Figure 17.3 may be used.

17.6.3 Patient Service Handling Capacity. The 5 minute peak handling capacity for patient service cars, not including materials or logistics traffic, shall be calculated as follows:

a. Total Moves / Day x 18.2% = Peak Hour Moves
b. Peak Hour Moves /12 = Average 5 Minutes
c. Average 5 Minutes x 1.25 = Peak 5 Minute Handling Capacity.

The Elevator Traffic Study and Analysis must detail these moves.

Select passenger elevator systems to provide a 35 second response waiting time interval based on 5 minutes of two way peak period traffic for the facility, assuming a maximum car capacity of 60 percent, that considers the worst case traffic loading scenario, computed using the most accurate of historical/actual traffic data or the projected traffic data/consideration set forth below:

a. Ten percent of the anticipated visitor and staff traffic.

b. Two percent of the anticipated ambulant inpatient traffic.

c. Two percent of the anticipated non-ambulant inpatient traffic.

d. Admissions/discharges based on 20 percent of the inpatient traffic (or a reasonable assumption).

e. Miscellaneous traffic loading not covered by the above factors (state assumptions).

17.6.4 Other Service Traffic (Materials, Housekeeping, Construction and Maintenance Traffic). Peaks for these traffic types shall be calculated in 15- minute intervals, with an allowance of a 5-minute peak representing 40% of the peak 15 minute total. Base studies on the actual total number of materials handling, logistics and housekeeping moves estimated by the materials handling analysis and the materials management report, plus 40% allowance for unscheduled moves and for future schedule flexibility, plus 4% allowance for construction and maintenance traffic.

Hospital service elevator systems will be selected to provide a 45 second response waiting time interval based on the most intense hourly traffic demand anticipated.

Clinic passenger/service elevator systems, either attached to a hospital or freestanding, will be selected to provide transportation to floors above grade at a 40 second response waiting time interval based on a 5 minute peak period for the facility that considers the worst case traffic loading scenario, computed using the most accurate of historical/actual traffic data or the projected traffic data/considerations set forth below:

a. Ten percent of the anticipated visitor and staff traffic.

b. Miscellaneous traffic and material handling traffic data (state assumptions.)

c. For broad planning purposes, including (a) and (b) above a factor of 16.6 percent may be utilized.

17.6.5 Average Maximum Ride Time (AMRT). Figure 17.4 lists the allowable Average Maximum Ride Time.

17.7 ELEVATOR DESIGN CONSIDERATIONS

17.7.1 Codes. Elevators shall be designed in accordance with all applicable Federal, State and local codes, including NFPA, "National Electrical Code", ASME A17.1, A17.2, A17.3 and A17.5 (reference 17a, 17b, 17c, and 17d). This includes designing to the appropriate rating/load classification for the intended application. Elevators shall be designed to meet all UFAS and ADAAG provisions applicable to the project.

17.7.2 Elevator Types. Elevator types and speeds shall comply with Figure 17.5. Higher speeds may be used if needed to satisfy traffic demands. Elevator selections will not exceed the elevator rise criteria given in Figure 17.5.

Electric traction elevators may be used for passenger service and hospital service applications.

Hydraulic powered elevators may be considered for use where vertical travel is less than 13.7 m (45 feet), or when overhead clearance is limited. Speed for hydraulic elevators will be minimal in the up direction with full rated loads. Valves that are contained in the pump unit assembly will control hydraulic acceleration, deceleration and leveling.

Hydraulic elevators rated for 80 starts per hour shall be utilized for light duty/light usage applications. Hydraulic elevators rated for 120 starts per hour shall be utilized for heavy duty/heavy usage applications.

17.7.3 Elevator Location and Travel Distances.

17.7.3.1 Passenger and Combined Use Elevators. Elevators will be located in direct relationship to major building entrances and convenient to major traffic generating functions such as lobbies. Passenger and combined use elevators shall be planned to provide a maximum walking distance of 61 m (200 ft). A distance of 46 m (150 ft) is preferred.

17.7.3.2 Service Elevators. Service elevators shall be planned to provide a maximum walking distance of 61 m (200 ft) for users on patient floors. A distance of 52 m (170 ft) is preferred.

17.7.3.3 Added Elevators. Where added elevators are provided solely for the purpose of meeting the distances noted above, and where they do not provide primary elevator service to main lobbies and main building ingress/egress points, they are exempted from the standard average interval and handling capacity criteria. Provide average intervals of under 55 seconds and handling capacity equal to 7.5% of the population within the area of service provided. Cars added for this purpose shall be service configured.

17.7.3.4 Materials Handling and Logistics Elevators. Plan materials handling and logistics elevators to provide service as close to the user areas as practical. Primary horizontal circulation should be on one level, where possible. Maximum distances for travel from the elevators to materials storage areas shall not exceed 53 m (175 ft) on inpatient floors and 61 m (200 ft) for all others, except for the primary horizontal circulation floor, where no limit is dictated.

17.7.3.5 Service Elevator Location. Locate elevators so that visitors do not normally pass service or materials cars en route to passenger cars, unless those service cars are substantially hidden from view.

17.7.4 Elevator Lobbies and Groupings.

17.7.4.1 Where four or more cars are required within a group, place cars in opposite banks, opening into a common lobby.

17.7.4.2 For service and combined use cars, two in a row are preferred and not more than three in a row should be used; for passenger cars three in a row are preferred and not more than four in a row should be used, as shown in Figures 17.6 and 17.7.

17.7.4.3 If more than six service cars, or eight passenger cars are required in one area, provide two smaller, strategic groups.

17.7.4.4 Place adjacent car entrances either in straight lines or in opposite banks to each other as shown in Figures 17.8 and 17.9.

17.7.4.5 Elevator ingress / egress should be from a distinct elevator lobby as shown in Figure 17.10 and not directly from a corridor. Minimum/maximum lobbies for service cars are:

a. 3.66 to 4.27 m (12 to 14 ft) when opening opposes a wall.
b. 4.27 to 4.88 m (14 to 16 ft) when the opening opposes another elevator.

Care should be taken to avoid creating dead end lobbies in excess of life safety requirements. Minimum / maximum lobbies for passenger cars are:

c. 3.05 to 3.66 m (10 to 12 ft) when the opening opposes a wall.

d. 66 to 4.27 m (12 to 14 ft) when the opening opposes another elevator.

Where elevators are accessed from corridors, as shown in Figure 17.11, they shall be located on one side of the corridor only (maximum of three cars), and shall be setback:

e. 2.44 m to 3.66 m (8-12 ft) for service and combined use cars.

f. and 1.22 m to 2.44 m (4-8 ft) for passenger cars.

17.7.4.6 Passenger and service cars shall not share the same lobby.

17.7.4.7 Where two or more elevator group lobbies are adjacent, provide walls or other building features to prevent a free flow of traffic between those lobbies (to minimize one user from placing calls to both groups).

17.7.4.8 Elevator lobbies generate noise and must be acoustically isolated from critical care areas.

17.7.4.8 All elevator equipment rooms should be electrically and acoustically isolated to prevent interference with building electronic equipment and objectionable noises. Elevator equipment rooms shall be acoustically separated from critical care and occupied rooms.

17.7.4.9 Hospital type elevator cars shall have interior dimensions that accommodate a patient bed with attendants. Cars shall be at least 1.73 meters (5'-8") wide by 2.74 meters deep (9'-0"). Car doors shall be side opening with a minimum clear opening of 1.22 (4-0") meters wide and 2.13 meters (7-0") high. In renovations, existing elevators that can accommodate patient beds used in the facility will not be required to be increased in size. Hospital type elevator cars Provide protective cab interior blankets. Wall mounted blankets for interior wall surfaces providing protective coverage from the finished floor to 300 mm (12") below the cab ceiling.

17.8 SYSTEMS DESIGN.

17.8.1 Transportation systems design will consider traffic demand, vertical travel distance, mix of traffic type in the areas to be served, and mode of containerization. Traffic demand and travel distance will determine equipment type and speed required. Traffic mix and mode of containerization will determine load capacity, platform size, configuration and door type.

17.8.2 Figure 17.12 illustrates a typical passenger elevator configuration, and figures 17.13 and 17.14 illustrate the configuration of typical hospital service elevators. Figure 17.13 is similarly applicable to typical clinic elevators. All hospital elevators (passenger and service) must be capable of transporting patient litters.

17.8.3 Front and rear opening hospital service elevators (Figures. 17.15 and 17.16) may be used as swing elevators for both passenger and service traffic when space or budget restrictions limit use of separate passenger elevators.

17.9 TRAFFIC DATA

17.9.1 Types of personnel and materials transactions define the nature of traffic circulating between various health facility departments. The following traffic factors may be used to compute traffic volumes for various traffic types, in lieu of specific direction from the User service.

17.9.2 Pedestrian Traffic Factors.

17.9.2.1 Assume the number of visitors to inpatient areas to average one visitor per inpatient bed per day.

17.9.2.2 Assume the number of professional and administrative staff to be 40 percent of the total facility population. Alternatively, the following ratio can be used: 1 staff for each 2.7 beds. Assume staff elevator trips to be two trips per day, including the total number of staff.

17.9.2.3 Assume ambulatory inpatients to comprise 60 percent of the inpatient census, and this number of inpatients will make 5 elevator trips each day.

17.9.2.4 Assume each clinic patient to have one accompanying person for a total of 2 persons per patient visit.

17.9.3 Nonambulatory patient and materials handling factors.

17.9.3.1 To determine the number for prepared food trays, multiply the number of meals served on all nurse units times the 3 meals served each day. The same dietary carts will be used for collection of soiled trays. The number of food carts will depend on the cart size chosen for a particular installation.

17.9.3.2 One patient nourishment cart will serve all patients on one ward, twice daily. The same cart will be used for collection of soiled nourishment containers.

17.9.3.3 Base linen cart capacity on a factor of 0.06 cubic meters (2 cubic feet) per bed for clean linen delivery, while 0.12 cubic meters (4 cubic feet) per bed is required for soiled linen collection. Limit linen supply carts to 1.2 cubic meters (40 cubic feet) capacity. Soiled linen return carts will depend upon the soiled linen collection system selected.

17.9.3.4 Base the number of sterile reprocessed supply carts on the following factors:

a. Surgery: The average number of surgical procedures per day times 1.2 carts per procedure, plus one backup cart per operating room per day.

b. Delivery: The average number of obstetrical deliveries per day times 1.5 carts per procedure, plus one backup supply cart per delivery room per day.

c. Emergency: The average number of patient visits per day times one cart for each 80 patient visits.

17.9.3.5 The required number of medication carts will be determined as follows:

a. Inpatient bed areas: One cart for each inpatient nursing unit.

b. Surgery and Delivery: The average number of procedures per day times one cart for each 20 procedures.

c. Emergency and Clinics: The average number of patient visits per day times one cart for each 160 patient visits.

17.9.3.6 Non-sterile supply carts will be provided as follows:

a. Inpatient Nursing Units: A volume of 0.05 cubic meters (1.7 cubic

feet) of non-sterile supplies will be needed for each bed each day. Each cart will be assumed to be of 0.85 cubic meters (30 cubic feet) capacity.

b. Radiology: One cart for every 300 radiographic procedures for each average day.

c. Laboratory: One cart for every 3,000 laboratory procedures for each average day.

d. Emergency and Clinics: The average number of patient visits per day times 0.06 cubic meters (2 cubic feet) of non-sterile supplies per visit per day.

e. Administration: One non-sterile supply cart for each 100 beds each day.

17.9.3.7 The number of gift and mail carts will be determined as follows:

a. Patient Nursing Units: One cart for every 40 beds each day.

b. Administration: One cart for every 100 beds each day.

17.9.3.8 Housekeeping supplies will require two carts per floor per day.

17.9.3.9 Waste collection factors will be as follows:

a. Inpatient Nursing Units: 0.3 cubic meters (one cubic foot) per bed per day.

b. Surgery and Delivery: One cart for each 20 procedures per average day.

c. Radiology: One cart for each 200 procedures per average day.

d. Laboratory: One cart for each 2,000 determinations per average day

e. Administration: One cart each day for every 100 beds.

f. Dietary: 0.06 cubic meters (two cubic feet) of dietary waste per bed each day.

g. Emergency and Clinics: The average number of patient visits per day times 0.06 cubic meters (2 cubic feet) of waste supplies per visit per day.

17.9.3.10 Compute inpatient stretcher trips as 40 percent of the average inpatient census times two trips per day.

17.9.3.11 Operation and maintenance activity procedures require 0.2 elevator trips per bed each day.

17.9.3.12 Special equipment supply procedures require one elevator trip per day per floor.

17.9.3.13 Inpatient administration and discharge activity produces elevator traffic equal for 20 percent of the hospital bed capacity times two trips per

day.

17.10 PASSENGER AND HOSPITAL SERVICE ELEVATOR FEATURES.

17.10.1 Operation. Elevators will be arranged to operate with or without attendants and will be provided with key operated switches for hospital priority service. Each elevator bank will be equipped for emergency operation by means of a key operated switch at each landing. This switch will cause the closest available car to bypass all other calls in response to an emergency call. Duplex collective operation shall be provided for two-car banks. Three or four car banks shall be group operation. An on-demand microprocessor system shall be provided for all elevator controls.

Controls shall operate properly with a 500 kHz to 1300 MHz radio frequency signal, transmitted at a power level of not less than 100 watts effective radiated power (ERP) at a distance of three feet. The equipment shall be provided with electro-magnetic interference (EMI) shielding within FCC guidelines. Noise level relating to the elevator equipment and its operation shall not exceed 80 dBa in the machine room, measured three feet above the finished floor and three feet from the equipment.

17.10.2 Code Blue Controls. Provide medical emergency elevator control, sometimes called Code Blue Control, as a means of overriding normal operation of elevators capable of medical emergency transportation of a patient in bed, accompanied by attendants. This control feature will be provided in conjunction with, or in addition to, controls provided for fire department emergency use. Firefighters' operation, as defined in ASME A17.1, shall override Code Blue Control.

17.10.3 Doors. Passenger and hospital service elevators will have center opening doors. Two-speed side opening doors may be provided in hospitals, which are equipped with separate material handling systems. Door closing time must comply with ASME code requirements. Minimum door opening speed will be 0.760 meters per second (2-1/2 feet per second) except for high speed elevators 2.54 meters per second (500 fpm) and over where the door opening speed will be 0.760 to 0.910 meters per second (2.5 to 3.0 fps.) Equip hospital service elevators with buttons to extend door open time, adjustable between 0 to 30 seconds. All elevator car doors shall be provided with infrared screen detectors.

17.10.4 Signals. Install hall position indicators at the main floor(s) containing the command and outpatient entrances. Provide hall push button stations with call register lights. Install hall lanterns with an audible signal on all elevators. Install car position indicators in each car with floor designations, a floor directory signal and direction arrows. Car operating panels will use car register type floor buttons. Provide a lobby control panel on elevator banks with two or more cars.

17.10.5 Emergency Power. Connect elevators to operate on alternate source emergency power in conformance with electric power and lighting criteria. Emergency power selection switches are required for each bank of elevators. The elevator control system will have an automatic transfer switch, which returns each elevator to the main floor, one car at a time. The last car to arrive at the main floor will automatically be selected to operate at normal design speed.

17.10.6 Machine Rooms. Locate electric traction elevator machine rooms

above elevator hoistways. Size machine rooms to accommodate the maximum space requirements anticipated from competitively bid projects, including adequate space to service the equipment. Provide air conditioning in machine rooms to maintain ambient temperature below 32 degrees centigrade and above 15 degrees centigrade (below 90 degrees F and above 60 degrees F.) Provide filters to remove dust. Size hydraulic elevator rooms accordingly for the equipment, adjacent or at least within 15 meters (50feet) of the elevator and should be on the lowest served floor.

17.10.7 Elevator Car Enclosure. Car lighting will be either indirect or of the luminous ceiling type. Provide mechanical exhaust for elevator cars.

17.11 MATERIALS HANDLING AND MANAGEMENT SYSTEMS CONSIDERATIONS

17.11.1 Adjacency Considerations and Handling Considerations. Figure 17.17 provides a guideline for adjacencies of materials management areas and functions.

17.11.2 Materials Handling System Alternative Matrix. The specific systems included in a project shall be determined by detailed physical, functional and economic including life cycle cost studies (LCC). As a minimum, consider the systems noted on Figure 17.17.

17.11.3 Manual Bulk Handling Systems. Use manual systems where semi or fully automated systems cannot be physically and economically (LCC) justified. Manual tasks such as pushing, pulling and carrying shall consider safety and human engineering factors. Designs should use general ergonometric standards applicable to "industrial women". Additional criteria for study / application of manual systems include:

17.11.3.1 Movement Loads. The design shall limit the sustained effort to move loaded carts to 10.43 kg (23 lb) pushing force where distances exceed 30.5 m (100 ft), on hard level surfaces. Initial forces required to initiate movement shall not exceed 22.68 kg (50 lb).

17.11.3.2 Movement Speeds. Use the following movement speeds when studying manual and automated alternates:

a. Walking unencumbered, through generally open corridor spaces - 1.32 m/s (260 FPM);

b. Walking while carrying tote box or medium sized parcel under 11.34 kg (25 lb) - 1.07 m/s (210 FPM)

c. Pushing cart through substantially straight and open areas - .89 m/s (175 FPM);

d. Pushing cart through areas that are congested, or where substantial numbers of turns are involved - 0.46 to 0.686 m/s (90 to 135 FPM);

e. Or, as recommended by the MTC based on restrictions of the location.

17.11.4 Semi-Automatic Bulk Handling Systems.

17.11.4.1 Elevators. Refer to the paragraphs above.

17.11.4.2 Gravity Chutes. Provide chute access on user levels through a separate room with dimensions adequate for holding the collection cart, with room doors closed, while the attendant is charging the chute. Where both laundry and trash chutes are used, each shall be in a separate and clearly marked room. Size terminal rooms to accumulate the amount of materials dictated by the waste management study. Minimum dimension shall allow accumulation of twenty-four hours of collected materials. Design shall ensure that collected material does not block the entrance door or hinder the pickup operation.

a. Consider gravity chutes, either alone or in combination with horizontal pneumatic chutes, for internal waste transportation in multi-story institutions. Also consider hospital service elevators and cart lifts for internal transportation of solid wastes in multistory buildings.

b. When gravity chute systems are included in multistory facilities, provide one chute system for soiled linen with a separate chute system for waste. Single chute, dual purpose systems will not be used. Separate charging areas, separate enclosure shafts and separate discharge rooms are required, although they may be side by side. Separate collection areas for soiled linen and for solid waste will be located near the loading dock. Bagged solid waste may be manually handled at the bottom of gravity chutes by loading the bags into carts, which are subsequently moved to the disposal point, or it may be automatically discharged into compactors.

c. Design gravity chutes in accordance with NFPA 82. The minimum diameter of gravity rubbish chutes will be 600mm (24 inches.) Chutes must penetrate the roof of the building, be within a fire rated enclosure, be provided with automatic sprinklers, and be charged within a fire-rated room, which is provided with automatic sprinklers. These requirements apply to both soiled linen and solid waste gravity chutes. Chutes are not required to be refractory lines.

d. Vertically aligned charging doors of the same chute system will be interlocked so that only one station can be charged at one time, thereby reducing the possibility of charges jamming within the chute. Provide gravity chutes with negative pressure, relative to the charging area, to eliminate aerosol discharged into the charging areas when charging doors are opened.

e. The concept design analysis will contain basic chute system recommendations.

17.11.4.3 Dumbwaiters, Counter Height. Automatic loading and unloading shall be considered. Dumbwaiters, without automated devices, shall have powered or manual doors. Powered doors shall be vertical lift type and have upper and lower safety edges.

17.11.4.4 Dumbwaiters, Floor Loading. Automatic loading and unloading shall be considered. Floor loading dumbwaiters shall have powered vertical lift bi-parting doors with both upper and lower safety edges.

17.11.4.5 Dumbwaiter Platform Size. Dumbwaiter systems will be limited to a maximum platform size of 0.8 square meters (9 square feet) and maximum

capacity of 225 kilograms (500 pounds). A platform size of 680mm x 1200mm (27 by 48 inches) is acceptable. Automatic loading and ejection devices of larger capacity and size, used in conjunction with automatic cart lifts, will conform to the ASME standards for elevators. Determine the dimensions of the car lift platform by the largest cart selected for dietary, linen or other materials distribution.

17.11.4.6 Speeds for automatic cart lifts will be as follows:

Number of Floors	Type of Drives	Rated Speed M/S	(fpm)
4 - 5	Geared	1.015	(200)
6 - 9	Geared	1.524	(300)
10 and over	Gearless	2.540	(500)

17.11.4.7 Dumbwaiter and Cart Lift Control. Distribution and Return programs will be provided for dumbwaiter and cart lift operation. The control station will contain a switch from program selection and a series of dispatch buttons that correspond to the floors served. Design the system to permit dispatching carts to any landing from the central dispatching area and to provide for return of carts only to the central dispatching area.

17.11.4.8 Dumbwaiter and Cart Lift Signals. Stations at each floor or landing will contain lights to indicate which program is in effect.

17.11.4.9 Cart lifts with automated transfer devices. Doors shall be power operated with upper and lower safety edges. Maximum cart lift capacity shall be 454 kg (1000 lb).

17.11.5 Auto Guided Vehicle System - Vertical Automation. Systems designed for vertical-only transportation of materials on carts shall use elevators, guide path, and other devices, as applicable. Designs shall consider future upgrade to allow horizontal travel.

17.11.6 Automated Horizontal and Vertical Bulk Handling Systems. Automated cart transportation systems may be used where LCC justified for horizontal and vertical transportation of materials.

17.11.6.1 Automated Guided Vehicle Systems. Automated Guided Vehicle Systems shall be an integrated turnkey automated cart transportation system. Design the Automated Guided Vehicle Systems to incorporate the latest state of the art in proven technology; systems not proven in previous applications shall be avoided. Automated Guided Vehicle Systems may utilize a variety of transportation vehicles including "cart carrying" type, forklift type, tow type, and Automated Storage and Retrieval System type.

Consider the use of automatic cart systems for material distribution provided the use of automated equipment can reduce the number of service elevators required and the installation can be justified on a cost effective basis. An increase in construction cost must be justified by a corresponding decrease in operating or other life-cycle, cost, through reduction of manpower needs, reduced energy consumption, or improved service to patients.

17.11.6.2 Other Automated systems. Other Automated Vertical and Horizontal Cart transportation systems may be reviewed where applicable and cost effective for a given project.

17.11.6.3 Pneumatic Trash / Linen. Pneumatic Trash / Linen shall be fully pneumatic, gravity pneumatic or multi-loading. Hybrid systems are permitted where required. In general, no station shall be designed that is "up-send" in nature. All materials should travel in the down direction after first being loaded into the system. Verify system traffic capabilities by detailed traffic studies.

a. Gravity-pneumatic systems, a combination of gravity chutes for vertical transportation and pneumatic chutes for horizontal transportation, are subject to the same fire protection requirements as gravity systems.

b. In composite systems, the gravity chute will be equipped with a storage section at the bottom of the chute. Gravity chute charging stations equipped with electric control systems may be loaded with as many bags of waste or linen as necessary. Bags are accumulated in the storage section and are removed as a single load on demand.

c. Fully automatic chute systems containing both horizontal and vertical elements, with automatic transfer systems, are not normally allowed in health facilities. Where a vertical rise is required for a pneumatic chute intended as a collector for gravity chutes, the vertical rise must be installed in a fire-rated enclosure in accordance with NFPA 82.

d. If horizontal pneumatic chutes must be manually charged, enclose charging doors and frames in fire-rated rooms. Sprinklers in the charging stations must protect pneumatic chutes. Charging stations will have a receiving compartment with an outer and inner door. When the door is opened to put in a load, the inner door will be automatically locked so that the load cannot freely enter the chute. When the outer door is closed, the inner door will open in its sequential turn and the load will be automatically transported by negative pressure to its point of discharge. Only one load will move through each leg of a pneumatic chute system at one time.

17.11.7 Unit Handling Systems.

17.11.7.1 Manual Systems. Use manual systems where semi, or fully automated systems cannot be functionally, physically or economically (LCC) justified.

17.11.7.2 Pneumatic Tubes. Pneumatic tube systems may be provided where economically justified. Design systems to reach individual project peak traffic requirements, plus a minimum spare capacity of 20%. Designs shall provide for soft handling of all systems where laboratory specimens and other delicate items are transmitted. No specific correlation can be made between the number of beds in a health facility and the need for a pneumatic tube system. Provision of pneumatic systems must be consistent with requirements for a particular health facility regardless of the size of the facility. Select tube systems which provide automatic control of carrier movement. A selector device which permits correspondence with any station served by the system will set destination of the carrier.

17.11.7.3 Automated Box Conveyors. Automated Box Conveyors systems may be provided when economically (LCC) justified. Design systems to serve peak traffic requirements plus a minimum spare capacity of 35%. Selective vertical

conveyors may be used to transport boxes approximately 400 mm wide x 1800 mm long x 200 mm deep (16 inches wide by 22 inches long by 8-1/2 inches deep). Box conveyors are suitable for transporting materials such as pharmaceuticals, sterile supplies, medical records, x-ray film and patient utensils. Conveyor systems are normally ratted at 8 boxes per minute. For large health facilities utilizing integrated materials handling methods, automatic loading an unloading cart lifts are considered more efficient than box conveyors.

a. The vertical element of a conveyor system will be equipped to load and unload automatically. The control stations will be capable of dispatching tote boxes to any landing or floor level in the building. Conveyors and branch lifts will be capable of transporting materials horizontally to remote stations.

b. Carrier tote boxes will be furnished with covers and will be coded to identify the type of material transported.

CHARACTERISTICS:	FACILITY TYPE:			
SIZE/HEIGHT OF BUILDING OR NUMBER OF BEDS OR NUMBER OF OUTPATIENT VISITS PER YEAR	TROOP AID CLINIC	MEDICAL AND OR DENTAL CLINIC	RESEARCH & GENERAL LAB BLDGS.	HOSPITAL
LESS THAN 4,640 GSM (50,000 GSF) OR 2 LEVELS OR LESS THAN 50 BEDS OR LESS THAN 15,000 OUTPATIENT VISITS/YR.	COMBINE ALL ELEVATORS	COMBINE ALL ELEVATORS	COMBINE ALL ELEVATORS	COMBINE ALL ELEVATORS
GREATER THAN 4,640 GSM (50,000 GSF) AND LESS THAN 9,2900 GSM (100,000 GSF) OR GREATER THAN 2 LEVELS OR GREATER THAN 50 BEDS AND LESS THAN 100 OR GREATER THAN 15,000 OUTPATIENT VISITS/YR AND LESS THAN 75,000 OUTPATIENT VISITS/YR.	NOT APPLICABLE	COMBINE ALL ELEVATORS OR SEPARATE PASSENGER AND SERVICE	COMBINE ALL ELEVATORS OR SEPARATE PASSENGER AND SERVICE	SEPARATE VISITOR/ OUTPATIENT TRAFFIC. SEPARATE INPATIENT/ LOGISTICS/ MATERIALS TRAFFIC.
GREATER THAN 9,290 GSM (100,000 GSF) AND LESS THAN 18,580 GSM (200,000 GSF) OR GREATER THAN 3 LEVELS OR GREATER THAN 100 BEDS AND LESS THAN 150 OR GREATER THAN 75,000 OUTPATIENT VISITS/YR AND LESS THAN 150,000 OUTPATIENT VISITS/YR.	NOT APPLICABLE	COMBINE ALL ELEVATORS OR SEPARATE PASSENGER AND SERVICE	SEPARATE PEDESTRIAN TRAFFIC. COMBINE LOGISTICS/ MATERIALS TRAFFIC.	SEPARATE VISITOR/ OUTPATIENT TRAFFIC. SEPARATE INPATIENT/ LOGISTICS/ MATERIALS TRAFFIC.
GREATER THAN 18,580 GSM (200,000 GSF) OR GREATER THAN 4 LEVELS OR GREATER THAN 150 BEDS OR GREATER THAN 150,000 OUTPATIENT VISITS/YR.	NOT APPLICABLE	SEPARATE VISITOR/ PATIENT TRAFFIC. SEPARATE LOGISTICS/ MATERIALS TRAFFIC.	SEPARATE PEDESTRIAN TRAFFIC. COMBINE LOGISTICS/ MATERIALS TRAFFIC.	SEPARATE VISITOR/ OUTPATIENT TRAFFIC. SEPARATE INPATIENT TRAFFIC. SEPARATE LOGISTICS/ MATERIALS TRAFFIC.

NOTES:

1. WAREHOUSES SHALL SEPARATE VISITOR TRAFFIC FROM ALL OTHER TRAFFIC.
2. WHERE A FACILITY MEETS CHARACTERISTICS IN MORE THAN ONE ROW, THE MORE SEVERE SEPARATION SHALL APPLY.

ELEVATOR TRAFFIC SEPERATION GUDE
FIGURE 17.1

FACILITY TYPE	PASSENGER CARS	COMBINE USE AND PATIENT SERVICE CARS	DEDICATED MATERIALS CARS (MANUAL SYSTEMS)
WAREHOUSE	LESS THAN 50 SECONDS	NOT APPLICABLE	LESS THAN 60 SECONDS
TROOP AID STATION	LESS THAN 45 SECONDS	LESS THAN 50 SECONDS	LESS THAN 60 SECONDS
MEDICAL AND OR DENTAL CLINIC	LESS THAN 40 SECONDS	LESS THAN 45 SECONDS	LESS THAN 55 SECONDS
RESEARCH LABS	LESS THAN 45 SECONDS	LESS THAN 50 SECONDS	LESS THAN 55 SECONDS
HOSPITALS	LESS THAN 35 SECONDS	LESS THAN 40 SECONDS	LESS THAN 50 SECONDS

AVERAGE INTERVAL PERFORMANCE STANDARDS
5 MINUTES OF HEAVY 2-WAY TRAFFIC
TYPICAL FACILITY
FIGURE 17.2

FACILITY TYPE	PERCENT OF ELEVATOR POPULATION HANDLED MINIMUM ACCEPTABLE, SEE NOTES 1 AND 2
WAREHOUSES, STAND ALONE	11%
TROOP AID STATION, STAND ALONE	12%
MEDICAL AND OR DENTAL CLINIC, STAND ALONE	13%
RESEARCH LAB BUILDINGS, STAND ALONE	13%
HOSPITALS, MEDICAL CENTERS	15%

NOTES FOR FIGURE 17.3:
1. WHERE COMBINED/INTEGRATED WITH ANOTHER FACILITY TYPE, THE HIGHER FACILITY CAPACITY SHALL BE MET.
2. WHERE MORE THAN ONE ELEVATOR GROUP EXISTS, A 10% (MINIMUM) MIGRATION FACTOR SHOULD BE INCLUDED FOR EACH GROUP.

PASSENGER HANDLING CAPACITY
5 MINUTES OF HEAVY 2-WAY TRAFFIC
TYPICAL FACILITY
FIGURE 17.3

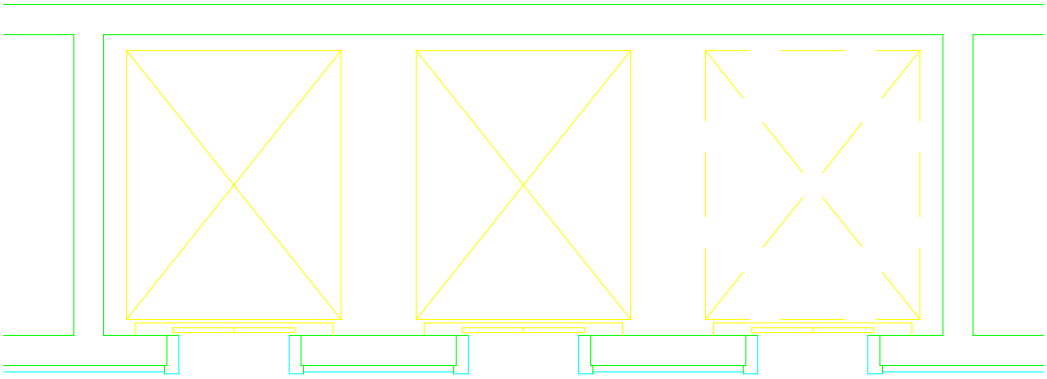
FACILITY TYPE	AVERAGE MAXIMUM RIDE TIME
WAREHOUSES, STAND ALONE	LESS THAN 120 SECONDS, ALL TRAFFIC
TROOP AID STATION	LESS THAN 90 SECONDS, ALL TRAFFIC
MEDIAL AND OR DENTAL CLINIC, STAND ALONE	LESS THAN 90 SECONDS, ALL TRAFFIC
RESEARCH/LAB BUILDINGS, STAND ALONE	LESS THAN 90 SECONDS, ALL TRAFFIC
HOSPITALS, MEDICAL CENTERS	LESS THAN 90 SECONDS, PASSENGER/PATENT ELEVATORS LESS THAN 120 SECONDS, LOGISTICS ELEVATORS

AVERAGE MAXIMUM RIDE TIME
FIGURE 17.4

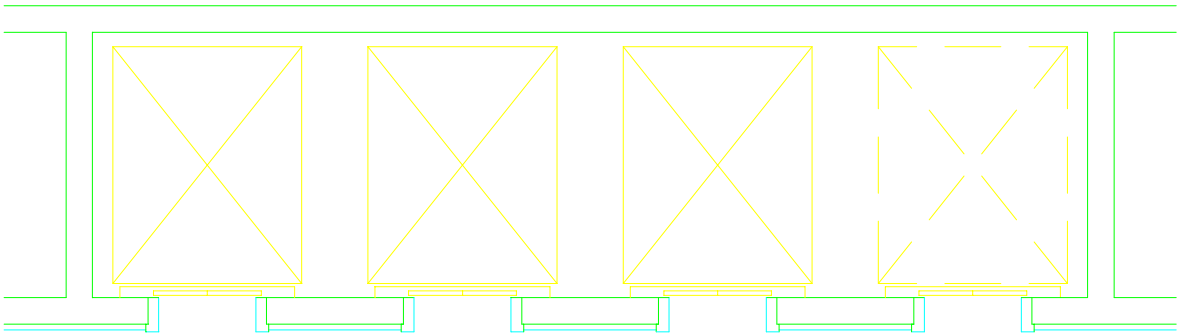
ELEVATOR RISE		SPEED M/S (FPM); FULL LOAD UP, NO LOAD DOWN; BY ELEVATOR TYPE		
STOPS	HEIGHT M (FT)	HYDRAULIC	GEARED	GEARLESS
2	< 4.6 (15)	.635 (125)	NOT APPLICABLE	NOT APPLICABLE
3	4.6 (15) TO 13.7 (45)	.635 (125 MIN.)	NOT APPLICABLE	NOT APPLICABLE
4 TO 7	< 27.4 (90)	NOT APPLICABLE	1.015 (200)	2.54 (500)
			1.780 (350)	
7 TO 17	27.4. (90) TO 54.9 (180)	NOT APPLICABLE	1.780 (350)	2.54 (500)
				3.56 (700)
> 17	> 54.9 (180)	NOT APPLICABLE	SEE NOTE 1	SEE NOTE 1

NOTES FOR TABLE 17.5:
1. CONSIDER SEPARATE HIGH RISE AND LOW RISE GROUPS OF PASSENGER CARS.

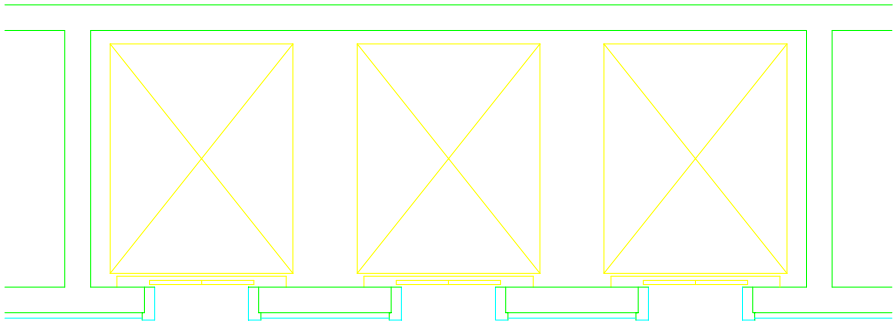
ELEVATOR TYPES AND SPEEDS
FIGURE 17.5



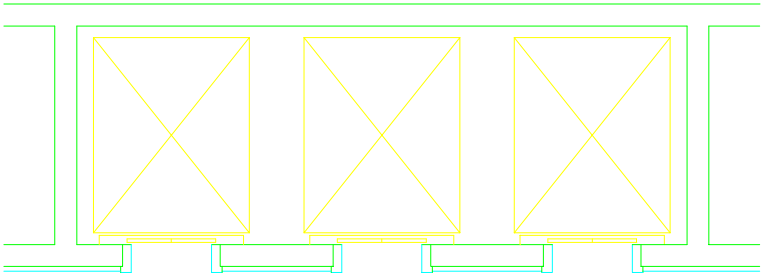
SERVICE CARS – IN LINE
FIGURE 17.6

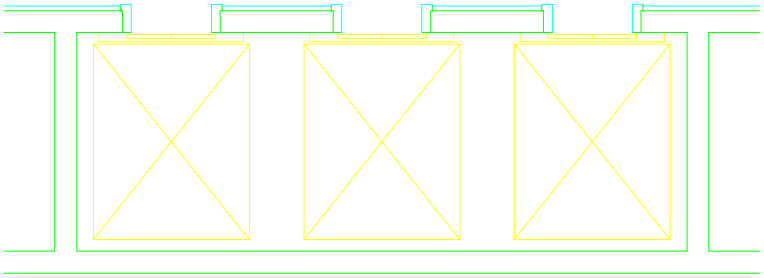


PASSENGER CARS – IN LINE
FIGURE 17.7

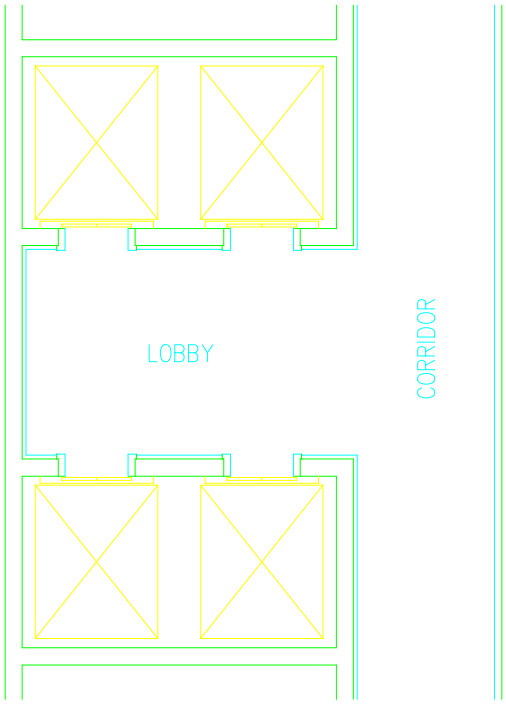


ADJACENT ENTRANCES – IN LINE
FIGURE 17.8

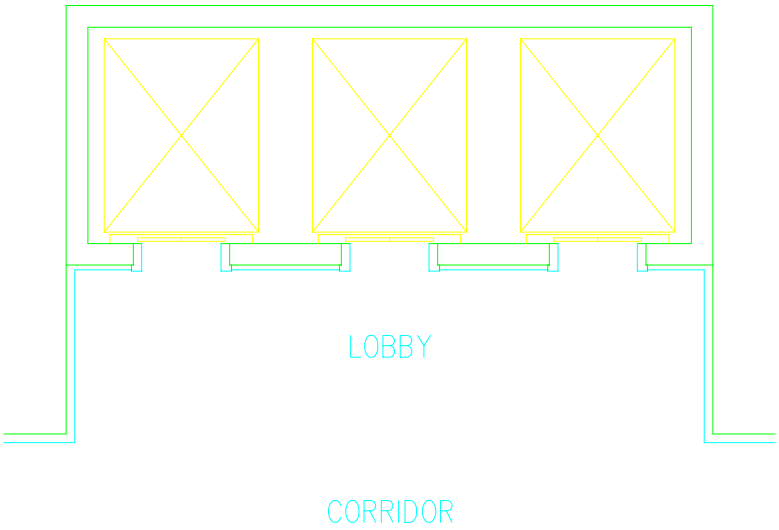




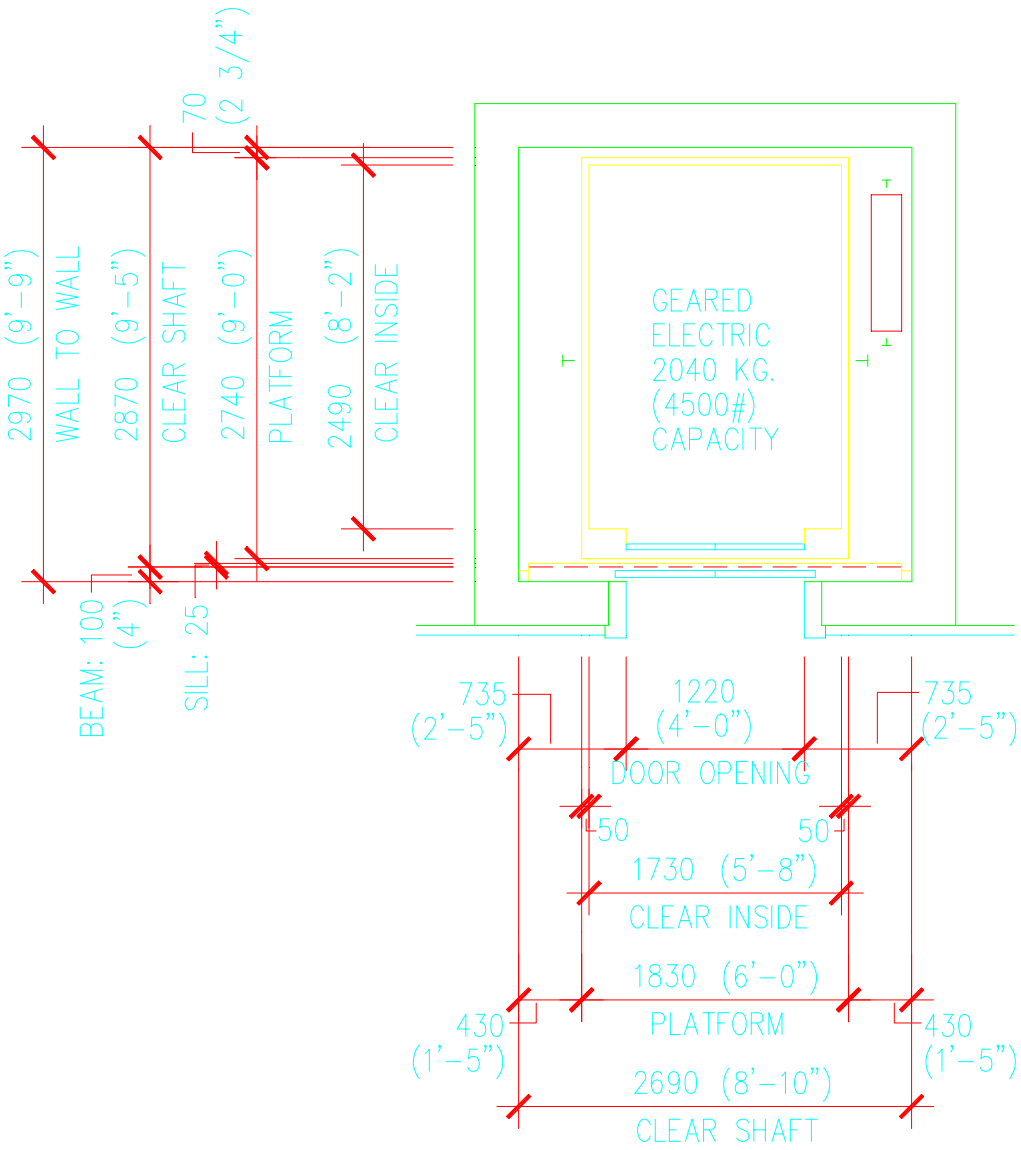
ADJACENT ENTRANCES – 180 DEGREES (OPPOSING)
FIGURE 17.9



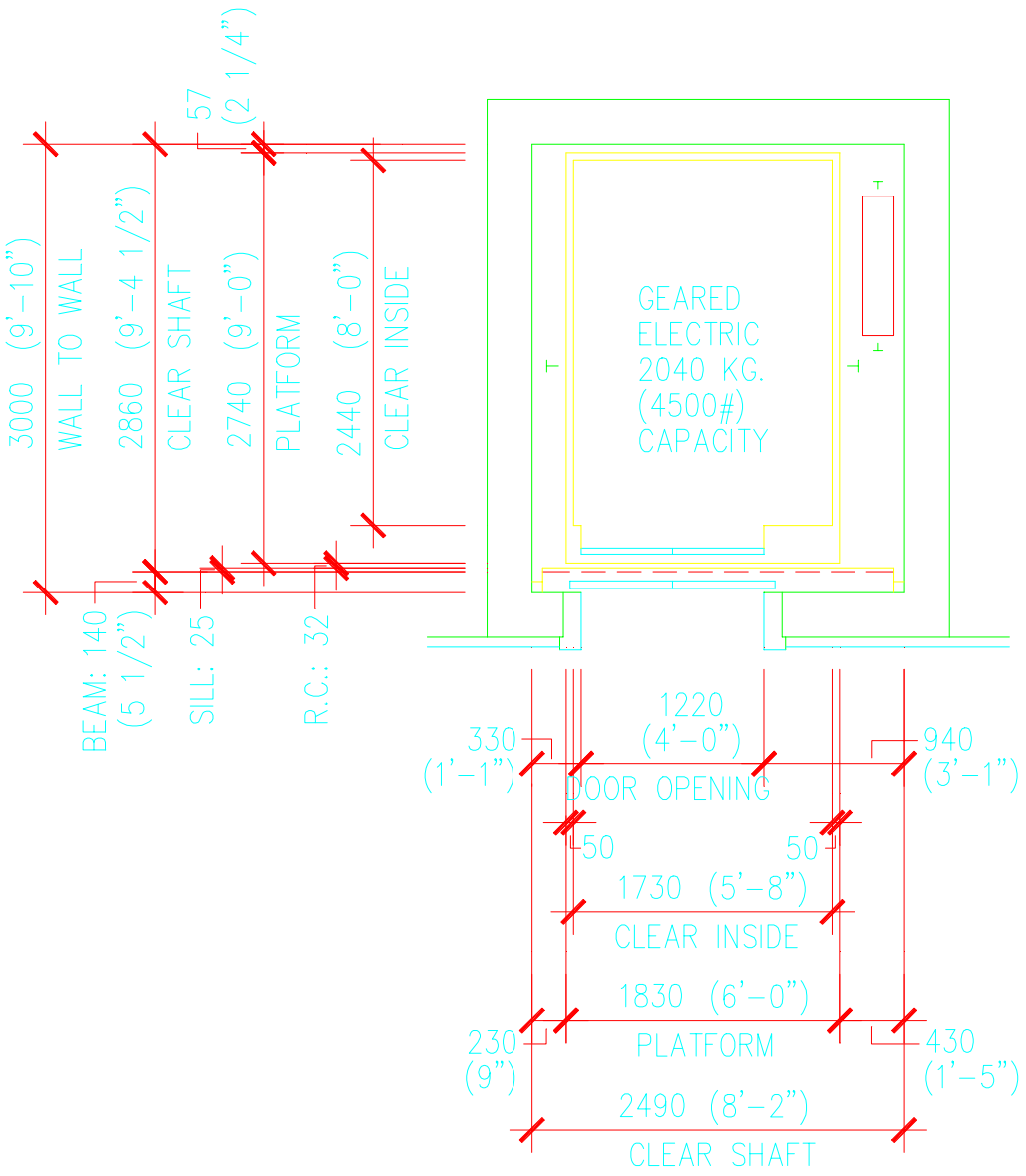
ELEVATOR WITH LOBBY ALCOVE
FIGURE 17.10



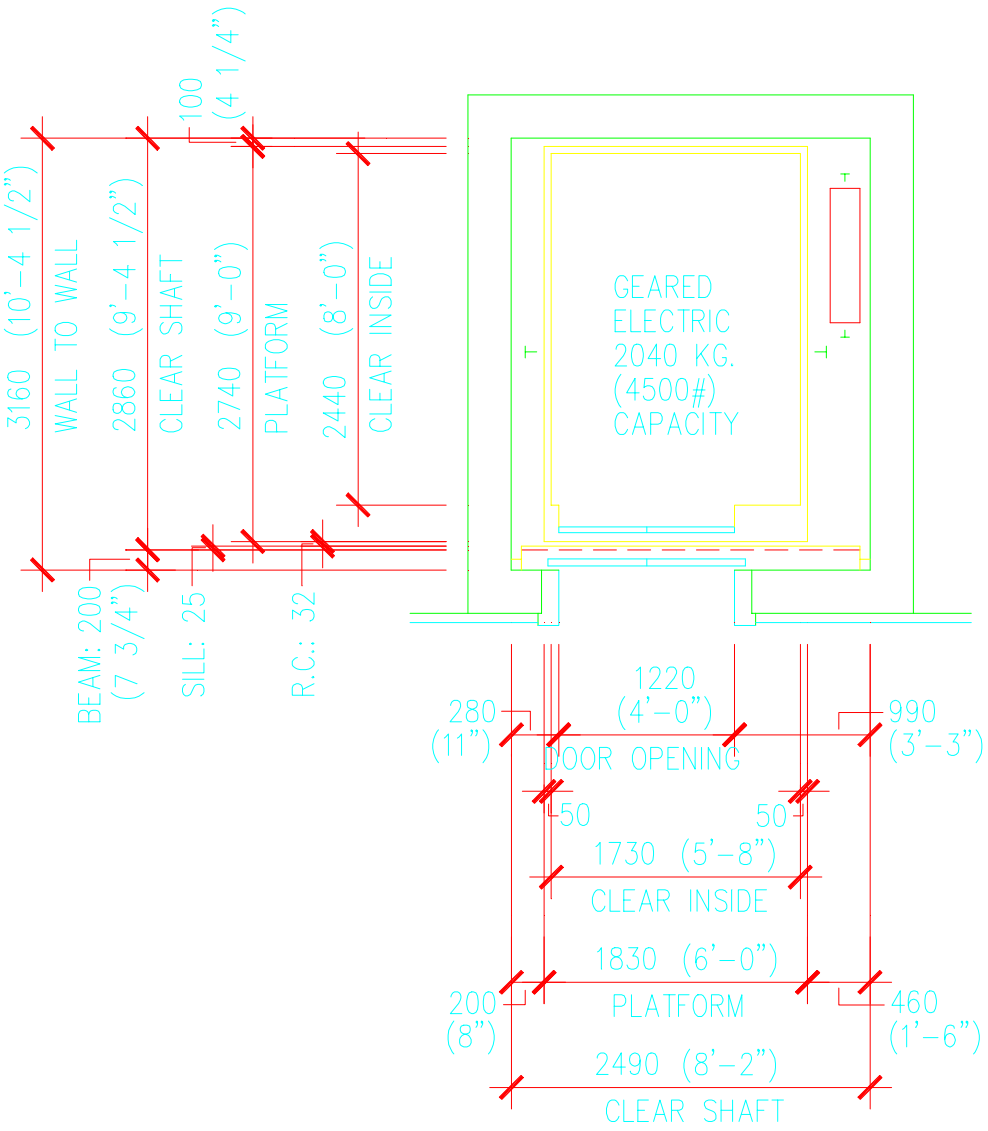
ELEVATOR WITH LOBBY SETBACK
FIGURE 17.11



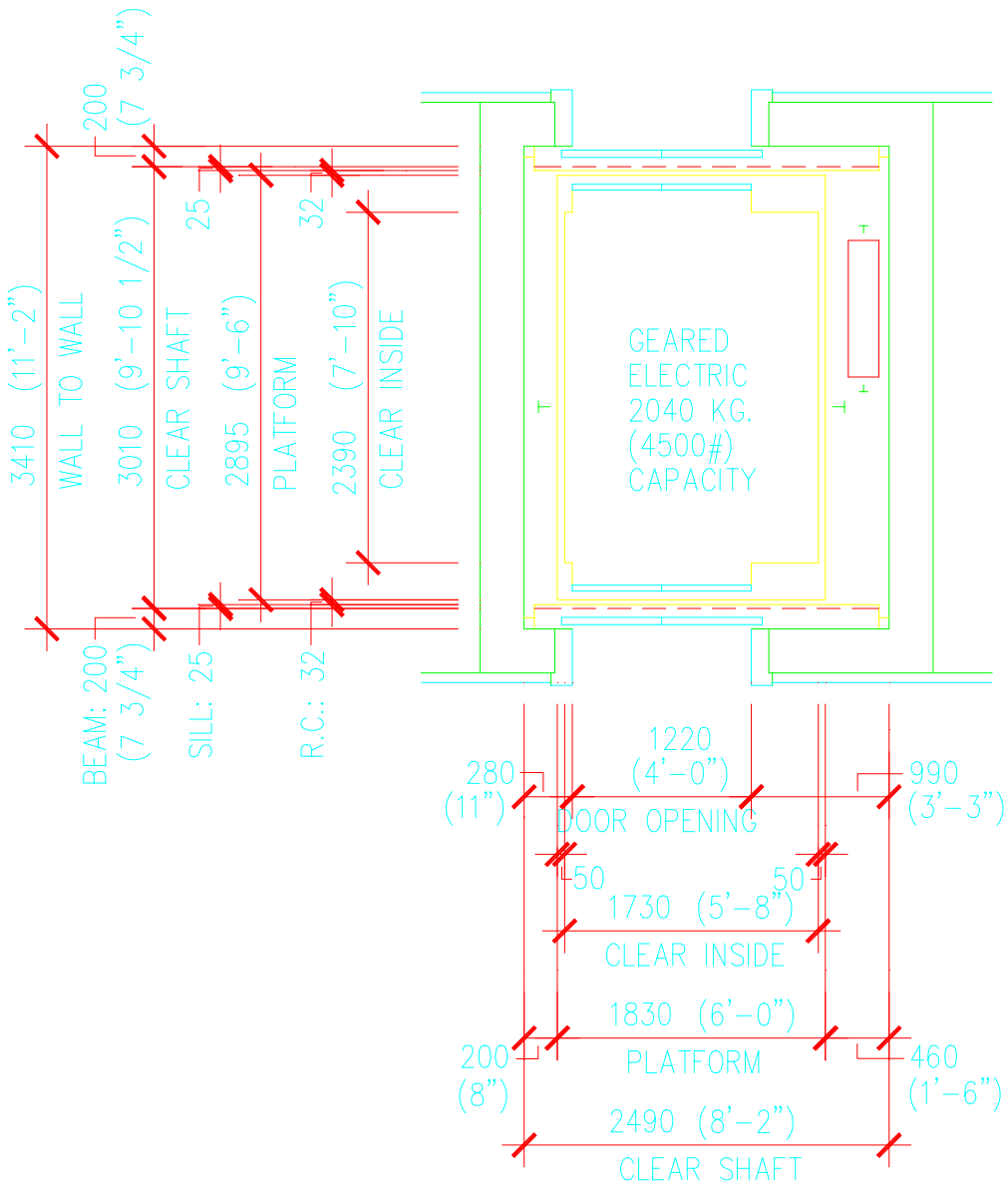
PASSENGER ELEVATOR – (NON SEISMIC)
FIGURE 17.12



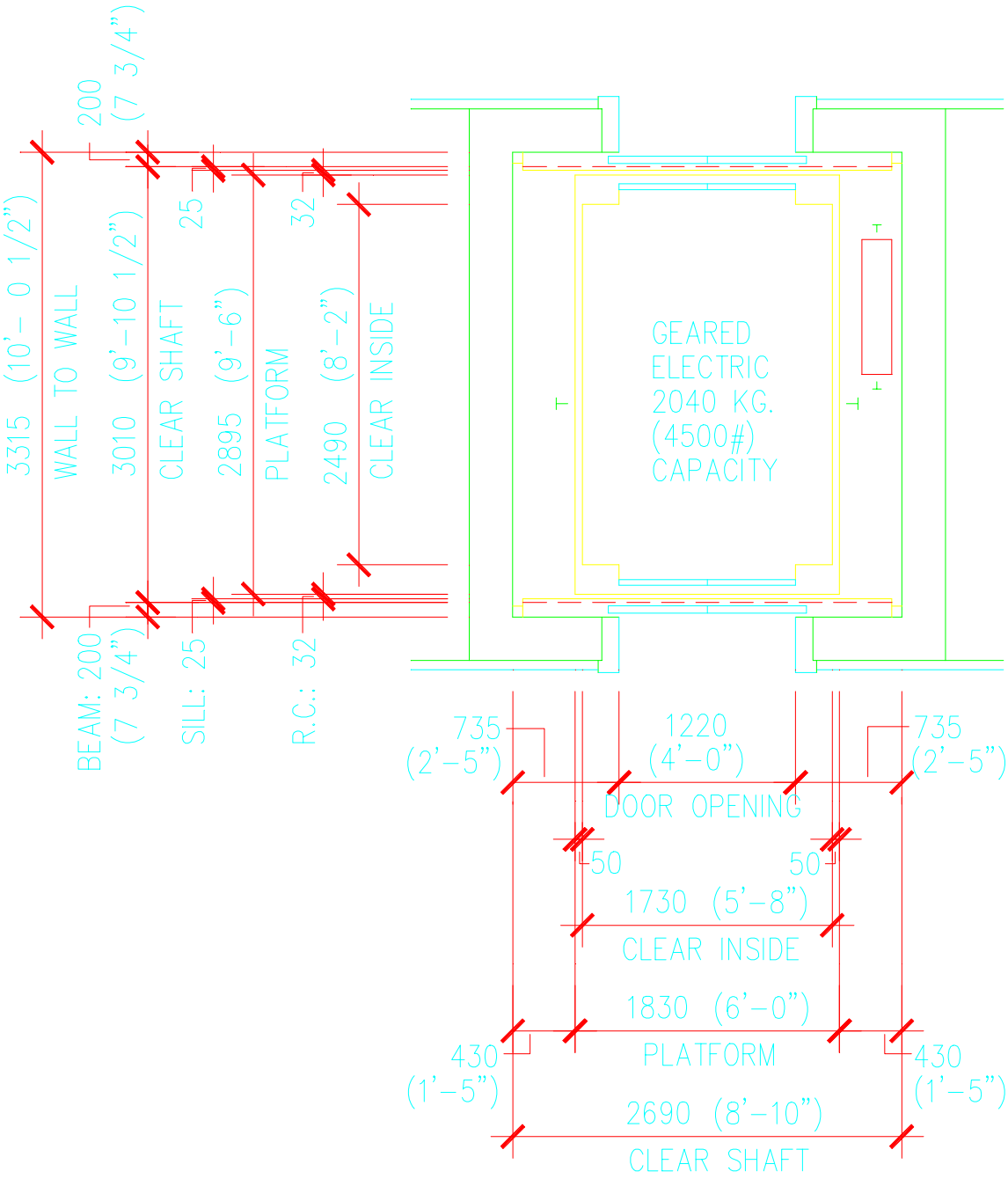
HOSPITAL SERVICE/PASSENGER ELEVATOR
WITH CENTER OPENING DOORS
(NON SEISMIC)
FIGURE 17.13



HOSPITAL SERVICE ELEVATOR
TWO SPEED SIDE OPENING DOORS
(NON SEISMIC)
FIGURE 17.14



HOSPITAL COMBINATION PASSENGER AND SERVICE ELEVATOR
CENTER OPENING DOORS, FRONT AND REAR
(NON SEISMIC)
FIGURE 17.15



HOSPITAL COMBINATION PASSENGER
AND SERVICE ELEVATOR
CENTER OPENING DOORS,
FRONT AND REAR
(NON-SEISMIC)
FIGURE 17.16

CHARACTERISTICS:	FACILITY TYPE:			
SIZE/HEIGHT OF BUILDING OR NUMBER OF BEDS OR NUMBER OF OUTPATIENT VISITS PER YEAR	TROOP AID CLINIC	DENTAL/ OUTPATIENT CLINIC	RESEARCH & GENERAL LAB BLDGS.	HOSPITAL
LESS THAN 4,640 GSM (50,000 GSF) OR 2 LEVELS OR LESS THAN 50 BEDS OR LESS THAN 15,000 OUTPATIENT VISITS/YR.	NO STUDY REQUIRED.	NO STUDY REQUIRED.	NO STUDY REQUIRED. MANUAL DUMBWAITER.	NO STUDY REQUIRED. MANUAL DUMBWAITER.
GREATER THAN 4,640 GSM (50,000 GSF) AND LESS THAN 9,2900 GSM (100,000 GSF) OR GREATER THAN 2 LEVELS OR GREATER THAN 50 BEDS AND LESS THAN 100 OR GREATER THAN 15,000 OUTPATIENT VISITS/YR AND LESS THAN 75,000 OUTPATIENT VISITS/YR.	NOT APPLICABLE	NO STUDY REQUIRED. MANUAL DUMBWAITER.	NO STUDY REQUIRED. MANUAL DUMBWAITER. PNEUMATIC TUBE - INJECT/EJECT.	STUDY TWO ALTERNATES. MANUAL DUMBWAITER. PNEUMATIC TUBE - INJECT/EJECT. GRAV. CHUTES
GREATER THAN 9,290 GSM (100,000 GSF) AND LESS THAN 18,580 GSM (200,000 GSF) OR GREATER THAN 3 LEVELS OR GREATER THAN 100 BEDS AND LESS THAN 150 OR GREATER THAN 75,000 OUTPATIENT VISITS/YR AND LESS THAN 150,000 OUTPATIENT VISITS/YR.	NOT APPLICABLE	STUDY TWO ALTERNATES. MANUAL DUMBWAITER. PNEUMATIC TUBE - INJECT/EJECT.	STUDY TWO ALTERNATES. MANUAL DUMBWAITER. PNEUMATIC TUBE - INJECT/EJECT.	STUDY THREE ALTERNATES. MANUAL DUMBWAITER. PNEUMATIC TUBE - INJECT/EJECT. AUTO CART LIFT GRAVITY CHUTE
GREATER THAN 18,580 GSM (200,000 GSF) AND LESS THAN 32,520 GSM (350,000 GSF) OR GREATER THAN 4 LEVELS OR GREATER THAN 150 BEDS AND LESS THAN 250 OR GREATER THAN 150,000 OUTPATIENT VISITS/YR. AND LESS THAN 300,000 OUTPATIENT VISITS/YR.	NOT APPLICABLE	STUDY TWO ALTERNATES. MANUAL DUMBWAITER. PNEUMATIC TUBE - INJECT/EJECT. AUTO CART LIFT AUTO BOX CONVEYOR GRAVITY CHUTE	STUDY TWO ALTERNATES. MANUAL DUMBWAITER. PNEUMATIC TUBE - INJECT/EJECT. AUTO CART LIFT AUTO BOX CONVEYOR GRAVITY CHUTE	STUDY THREE ALTERNATES. MANUAL DUMBWAITER. PNEUMATIC TUBE - INJECT/EJECT. AUTO CART LIFT AUTO BOX CONVEYOR GRAVITY CHUTE PNEUM. TRASH/LINEN

MATERIALS HANDLING SYSTEM ALTERNATIVE MATRIX
FIGURE 17.17
(CONTINUED NEXT PAGE)

CHARACTERISTICS:	FACILITY TYPE:			
SIZE/HEIGHT OF BUILDING OR NUMBER OF BEDS OR NUMBER OF OUTPATIENT VISITS PER YEAR	TROOP AID CLINIC	DENTAL/ OUTPATIENT CLINIC	RESEARCH & GENERAL LAB BLDGS.	HOSPITAL
GREATER THAN 32,520 GSM (350,000 GSF) OR GREATER THAN 6 LEVELS OR GREATER THAN 250 BEDS OR GREATER THAN 300,000 OUTPATIENT VISITS/YR.	NOT APPLICABLE	STUDY THREE ALTERNATES. MANUAL DUMBWAITER. PNEUMATIC TUBE - INJECT/EJECT. AUTO CART LIFT AUTO BOX CONVEYOR GRAVITY CHUTE PNEUM. TRASH/LINEN AUTO GUIDED VEHICLE	STUDY THREE ALTERNATES. MANUAL DUMBWAITER. PNEUMATIC TUBE - INJECT/EJECT. AUTO CART LIFT AUTO BOX CONVEYOR GRAVITY CHUTE PNEUM. TRASH/LINEN AUTO GUIDED VEHICLE	STUDY THREE ALTERNATES. MANUAL DUMBWAITER. PNEUMATIC TUBE - INJECT/EJECT. AUTO CART LIFT AUTO BOX CONVEYOR GRAVITY CHUTE PNEUM. TRASH/LINEN AUTO GUIDED VEHICLE

NOTES:

1. WAREHOUSES SHALL BE STUDIED FOR APPLICABLE EQUIPMENT AND FOR EXTENSIONS OF SYSTEMS FROM ADJACENT FACILITIES.
2. OTHER SYSTEMS MAY BE STUDIED WHERE APPROPRIATE.

MATERIALS HANDLING SYSTEM ALTERNATIVE MATRIX
FIGURE 17.17

REFERENCES

17a. ASME A17.1, "Safety Code for Elevators and Escalators".

17b. ASME A17.2.1, A17.2.2, A17.2.3, "Inspectors Manuals".

17c. ASME A17.3, "Safety Code for Existing Elevators and Escalators".

17d. ASME A17.5, "Elevator and Escalator Electrical Equipment".

17e. NFPA 82, "Standard on Incinerators and Waste and Linen Handling Systems and Equipment".